CZYSTA MOC ENERGII

LESSON PLAN

Why is the world moving away from fossil fuels?

LESSON DURATION 45 min HIGH SCHOOL CLASS

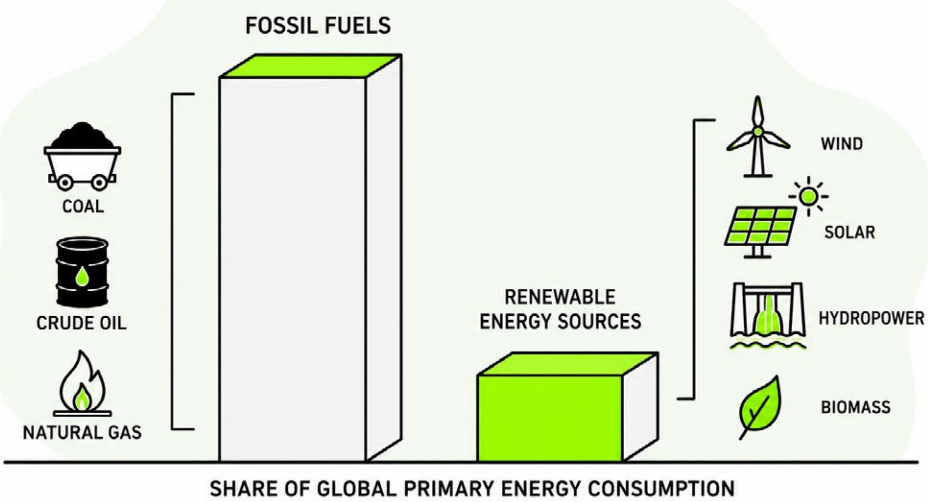
Students will learn why the modern world is gradually moving away from fossil fuels and the reasons behind this shift: climate-related, strategic, and industrial. The lesson presents the energy transition not only as a response to climate change, but also as a process that affects national security, economic competitiveness, and the development of new technologies.

By the end of the lesson, students should be able to answer the following questions:

1. Why do fossil fuels still play such an important role in the global economy?
2. How does the combustion of fossil fuels affect the climate and greenhouse gas emissions?
3. What is the greenhouse effect, and why is its intensification a problem?
4. Why does an increase in the Earth's average temperature of about 1.2–1.3°C have serious consequences?
5. Why is adaptation to climate change alone not sufficient?
6. How does dependence on oil, gas, and coal affect national security?
7. Why is energy considered a geopolitical issue?
8. How can renewable energy sources, energy storage systems, and electrification increase countries' resilience to crises?
9. Why is the energy transition also an economic and industrial opportunity?
10. How might the energy transition affect jobs, regions, and local communities?

SEGMENT 1

An introduction to the discussion on the current energy paradigm of the global economy



Fossil fuels still account for approximately **80% of global primary energy consumption**. The situation is somewhat better in the electricity sector: **fossil fuels account for approximately 60%** of global electricity generation.

This arrangement (paradigm) is a legacy of the First Industrial Revolution, which involved a rapid increase in energy consumption— people today consume about 70 times more energy per year than people living in the mid-19th century;
This has consequences: over the past 200 years, the burning of fossil fuels has contributed to the fastest increase in greenhouse gas emissions and global average temperature in Earth's known geological history. Atmospheric **CO_2 concentrations** have risen by 50% (from approximately 290 to 430 parts per million), and the global average temperature has increased by **1.2–1.3°C**.

The energy transition currently underway worldwide is also an **industrial revolution**. Its aim is to change how energy is managed: the global economy is to continue relying on high energy consumption, but supply methods are to become low- and zero-emission.
The energy transition is taking place for three main reasons: climate, strategic, and industrial.

SEGMENT 2

The climate-related reason for the energy transition

The burning of fossil fuels is the primary source of anthropogenic greenhouse gas emissions, accounting for approximately **70–75% of global emissions** of these substances. The remainder consists mainly of methane released by industrial livestock farming.
The key mechanism behind modern **global warming** is the greenhouse effect, a natural physical phenomenon without which the Earth would have an average temperature of approximately -18°C. It works as follows: the atmosphere allows solar radiation to reach the Earth's surface but partially traps infrared radiation (heat) emitted after reflecting off the planet's surface; this is due to so-called greenhouse gases, primarily water vapor, carbon dioxide, methane, and nitrous oxide. The problem with current climate change is not the existence of the greenhouse effect itself, but its amplification by **human activity**: for example, an increase in the concentration of CO_2 or methane in the atmosphere causes more thermal energy to be "trapped" in the Earth's climate system;

The effect of these emissions is **cumulative**: chemical compounds such as CO_2 and methane remain in the atmosphere for tens to hundreds of years, meaning that the effects of historical industrialization continue to accumulate, even if the rate of emissions were to stop.
This process has resulted in a rise in the global average temperature of approximately 1.2–1.3°C compared to pre-industrial levels (i.e., before 1850), which is already leading to more frequent and intense heat waves, droughts, floods, and **extreme** weather events.

The effects of temperature rise are not linear: every additional 0.1°C increases the risk of exceeding critical thresholds in the climate system. Already, every second, Earth's atmosphere absorbs as much additional energy as would be released by 12 nuclear bombs dropped on Hiroshima. This can be expressed by the following equation: **$12 \times (6.3 \times 10^{13}$ J)**, or (12 times 63 trillion joules). For comparison: it takes 4,190 joules to heat one liter of water by 1 degree Celsius. The energy transition in the context of climate change is therefore preventive in nature: its goal is to limit further increases in greenhouse gas concentrations and avoid scenarios in which adaptation to climate change becomes insufficient or impossible

Possible discussion questions:

The climate has always changed, so what is so extraordinary about this?
In the past, Earth's climate changed naturally, but usually over a timescale of thousands or even tens of thousands of years. Current warming is occurring at a rate measured in decades and is directly linked to greenhouse gas emissions from the burning of fossil fuels. The difference lies not in the phenomenon of change itself, but in its speed and cause—current climate change is about 30 times faster than the fastest such processes known from geology; for the first time, it is also the result of the actions of a single species living on Earth.

Does CO_2 really have such a significant impact on the climate, given that it makes up only 0.04% of the atmosphere?
CO_2 acts as a regulator of the planet's energy balance. It doesn't need to be present in large quantities to be significant; what matters is its ability to absorb infrared radiation. Increasing its concentration causes more energy to remain within Earth's climate system. Moreover, this "0.04% of the atmosphere" is responsible for all biological life on the planet, as carbon dioxide is essential, for example, in the process of photosynthesis. One can also try a thought experiment: ingesting a dose of poison (e.g., potassium cyanide) equivalent to 0.04% of an adult's body weight would be fatal—which demonstrates that even a small amount of the right substance can have catastrophic consequences.

How do we know that humans are responsible for global warming, and not the Sun?
Changes in solar radiation do not explain the observed steady upward trend in global average temperature. The amount of energy coming from the Sun varies over time—but given these variations, Earth's temperature should currently be falling, yet it is rising rapidly.

Does a 1.2°C increase really make a difference?
The climate system does not operate linearly. Even small average changes translate into large changes in the system as a whole. This can be compared to human body temperature. On the surface, the difference between 36.6 and 38°C is small, but how one feels in these two states changes dramatically.

Isn't it better to just adapt?
Adaptation is necessary, but it has its limits. We can build flood barriers and strengthen cities' resilience, but we cannot adapt indefinitely to rising temperatures and weather extremes. The energy transition addresses the root of the problem—it slows the pace of change that we must already adapt to.

10 min

SEGMENT 3

The strategic rationale for the energy transition

The world's current energy system is heavily dependent on fossil fuels, whose reserves and production are unevenly distributed **geographically**, creating lasting commercial and political dependencies between energy importers and exporters;

In practice, this means that energy—a fundamental resource for the economy—remains a matter of geopolitics rather than solely a market issue, a fact particularly evident in the case of oil and natural gas;

The concentration of most production in a limited number of countries creates so-called **"strategic chokepoints,"** where supply disruptions (wars, sanctions, political decisions, internal instability) can immediately affect importing economies. Such points include not only individual countries (e.g., Russia, Iran, Venezuela, Saudi Arabia, the U.S.), but also transportation **arteries—straits** (Hormuz, Malacca), **canals** (Suez Canal, Panama Canal), and **pipelines** (Nord Stream, Druzhba);

An example of this dependency is **Europe,** which bases its energy security on raw material imports, limiting its autonomy in economic and foreign policy. Between 2021 and 2026, Europeans faced an energy crisis twice due to disruptions in fossil fuel supplies;

Fossil fuels are both stored and transported **globally,** making them vulnerable to **price shocks** resulting not only from supply and demand but also from geopolitical risks. For example, due to the 2022 energy crisis, natural gas on the European market was 35 times more expensive than in the U.S.;
The energy transition—involving a shift to local sources of **electricity generation** and storage, combined with the strategic electrification of the economy—aims to reduce this dependence;
In this sense, the transition from fossil fuels to low-carbon sources is an attempt to "depoliticize" part of the energy system and reduce the vulnerability of economies to external pressures;
The energy transition thus becomes a tool for increasing states' **strategic sovereignty** and, consequently, their strategic resilience in the face of growing international instability.

Possible discussion questions:

Does the energy transition provide complete autonomy?
The energy transition enables a shift from importing fossil fuels to importing technology. This means less vulnerability to individual supply shocks and the political decisions of a few countries. Technologies—unlike raw material deposits—are immeasurably easier to relocate geographically (a factory can be moved, but oil deposits, for example, cannot) and more durable once imported (coal brought in from abroad is burned immediately, while an imported photovoltaic panel operates for 20–25 years). It is worth noting that in the global economy, there is no system completely free of dependencies—there are only systems with varying levels of risk.

Do renewable energy sources not create new state dependencies, e.g., on China and critical raw materials?
The transition does not completely eliminate dependencies, but rather shifts and limits them: from fossil fuels to technology supply chains, which are not continuous but one-time. These goods are harder to "cut off" than, for example, gas or oil supplies, because they do not require constant imports, and the imported components last for decades.

Why is energy a geopolitical issue at all?
Without energy, nothing works: industry, transportation, the military, the financial system. Countries that control energy sources or their flow gain real political influence that is hard to resist. That is why oil and gas have been tools of pressure for decades, not just commodities. The world learned this lesson, for example, in 1973, 1979, 2022, and 2026.

Is Europe really "energy-dependent"?
Europe has very limited reserves of its own fossil fuels, so it has relied on imports for years. European Union countries import 75% of the coal they consume, 90% of their gas, and 97% of their oil and other fuels. The transition aims to reduce this dependence through local energy sources and the electrification of the economy.

Won't the transition be too expensive?
The transition will cost a lot of money, but sticking with fossil fuels will be truly expensive - especially in Europe. In 2022 alone, the European Union had to inject 1 trillion euros into the market to stabilize energy prices due to the fossil fuel supply crisis. Meanwhile, between 2021 and 2024, EU countries paid €1.8 trillion for imported energy resources. This means that in just four years, the EU spent more on imports and the fossil fuel crisis than Poland plans to spend on its energy transition by 2050.

SEGMENT 4

The Industrial Rationale for the Energy Transition

The energy transition is not merely a cost; it is also a process of creating **new economic sectors** and restructuring existing value chains.
The development of low- and zero-emission technologies is generating new markets of growing scale, where global competition for market share and technological advantages is beginning.

Countries and companies that **build industrial capabilities** in these areas early on can gain lasting economic benefits: jobs, technology exports, and control over key segments of the supply chain. For example, China already derives 11% of its GDP from sectors related to the transition.

At the same time, the transition poses a **risk to fossil fuel-based sectors**. Assets such as coal-fired power plants or mining infrastructure may lose their economic value.

The nature of economic competitiveness is also changing: **energy costs and the carbon footprint** of production are becoming increasingly important, which affects industrial location and market access (e.g., through climate regulations and mechanisms such as emissions trading).

The energy transition also necessitates the **development of new technological and organizational capabilities,** such as the digitization of energy systems, demand management, and the integration of distributed energy sources.

Possible discussion questions:

Is the energy transition a cost or an opportunity for the economy?
Both, but over different time horizons. In the short term, it means significant capital expenditures and pressure on existing sectors. In the long term, it creates new markets, jobs, and technological advantages. The problem is who will survive the cost phase and make it into the profit phase.

Who is currently benefiting industrially from the transition?
First and foremost, countries that have rapidly scaled up production of low-carbon technologies, such as China. But the game is not over yet: Europe and the U.S. are trying to rebuild their capabilities through appropriate industrial policies.

Are old sectors, such as mining or conventional energy, doomed to shut down?
The importance of these industries will decline. The problem is not the very existence of these sectors, but their economic viability in a world of rising emission costs and competition from cheaper technologies. It is a process of contraction rather than sudden disappearance. Nevertheless, industrial revolutions are phenomena that profoundly transform economies—for example, the First Industrial Revolution brought about a very significant reduction in the use of animals for transportation and a decline in employment in related professions.

Why is the cost of energy so important to industry?
Energy is one of the basic costs of production. If it is expensive or unreliable, industry loses its competitiveness. That is why access to affordable and predictable energy is becoming one of the main factors determining where investments are made.

Does the transition mean the “deindustrialization” of Europe?
Only if it is poorly executed. High energy prices and regulations may drive industry out of the EU, but at the same time, the transition offers an opportunity for the development of new sectors of the economy. In other words: this is not a foregone conclusion, but rather a complex game with many possible scenarios.

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SEGMENT 5

Wrap-up discussion

How will the transformation affect the region?

Are the results of this process already visible in the area?

Which transformation technologies have become the norm today?

Notes: